Office of the Director
WSR-88D Radar Operations Center
September 15, 2004

MEMORANDUM FOR: NWS Science and Operations Officers and WSR-88D Points-of-Contact

FROM: W/OPS4 - Richard Vogt

SUBJECT: Guidance on WSR-88D New Adaptable Parameter Settings for Exclusion Zones and VCP 121

This memo contains important information about changes in RPG Build 6 software that meteorologists using the WSR-88D should consider. We discuss two issues:

1) Hard-coded exclusion zones, called “special” exclusion zones in this memo, are not implemented in Build 6; and,

2) A common, but minor, velocity product display problem related to Volume Coverage Pattern (VCP) 121 is corrected.

Regarding issue #1, because of differences between Build 5 and Build 6 software, field sites may need to manually implement special exclusion zones. Meteorologists at WSR-88D sites need to decide *if* exclusion zone adaptable parameters should be updated at the Master System Control Function (MSCF). Attachment 1 explains site-specific Build 6 exclusion zones.

Special exclusion zones were hard-coded in RPG Build 5. Operators were unable to see the values of these special exclusion zones. The Radar Operations Center did not provide special exclusion zones in Build 6 since some sites do not require them. At each WSR-88D site, staff should decide if and how special exclusion zones will be updated for Build 6 based upon information provided in Attachment 1. Generic information about creating exclusion zones at an RPG can be found in Build 5 training material available on the WDTB web pages at:

http://www.wdtb.noaa.gov/modules/RPG5/build5deploy.pdf

Regarding issue #2, forecasters at many sites see narrow concentric rings in velocity and related products near the end of first trip while using VCP 121. Attachment 2 explains this problem and how it is corrected in Build 6. Sites may need to change adaptable parameters affecting performance of VCP 121.

Please call the WSR-88D Hotline, 1-800-643-3363, if you would like assistance in deciding whether to make changes to your exclusion zones or VCP 121 adaptable parameters. The field-wide release of RPG Build 6 begins on 30 September 2004.

Attachments

Attachment 1

Operational Impacts of RPG Build 6

Exclusion Zones

RPG Build 6 software will not contain hard-coded exclusion zones that were once a special solution to false precipitation accumulations caused by ground clutter. Meteorologists at each site should decide *if* and *how* exclusion zones should be used with their WSR-88D. If false precipitation accumulations from ground clutter cannot be eliminated with maximum clutter suppression then exclusion zones are probably needed.

For Build 6 installation some WSR-88D sites may require manual entry of the special exclusion zones that were automatically included in Build 5 since those sites will experience false precipitation accumulations in precipitation products due to ground clutter returns. Other sites may choose to define site-specific exclusion zones or may not require exclusion zones at all. The best solution, if exclusion zones are required, is to define small, less intrusive exclusion zones tailored over persistent ground clutter targets.

What are exclusion zones?
Exclusion zones are radar coordinate regions defined by adaptable parameters in the RPG MSCF that exclude reflectivity values that would otherwise be used by precipitation algorithms.

What are special exclusion zones?
For RPG Build 5 software developers hard-coded *three* exclusion zones that were hidden from view. After using clutter suppression techniques, certain fixed regions ("special exclusion zones") were chosen as a single solution to prevent ground clutter residue from accumulating as precipitation. These fixed regions were chosen based upon assumptions

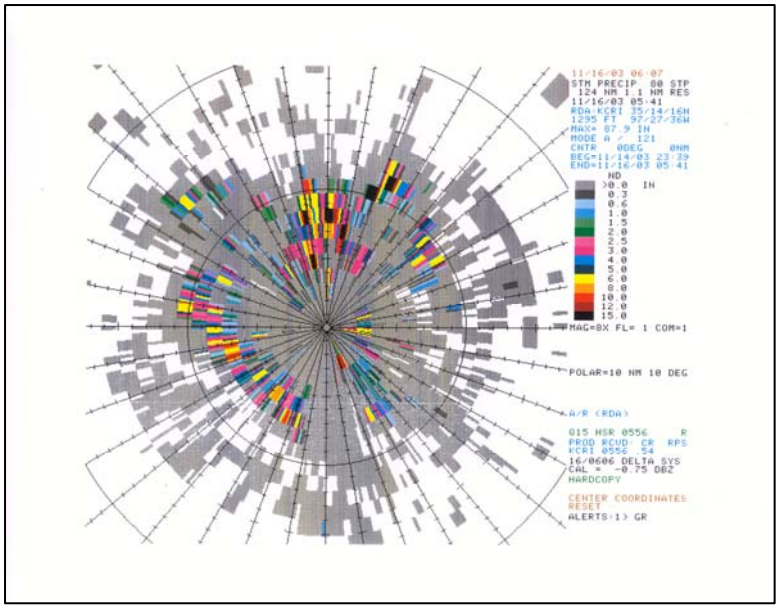

Figure 1 – False precipitation totals may occur in precipitation products solely due to ground clutter. Exclusion zones will eliminate the ground clutter problem but may also reduce real precipitation totals in precipitation accumulation products.

of flat-earth terrain and a tower height of 15 meters; they were not tailored to specific sites.

When should I use special exclusion zones?
Without special exclusion zones some sites will see excess precipitation in products caused by ground clutter (see Figure 1). When widespread anomalous precipitation totals close to the radar (out to approximately 25 n mi) are observed, it is recommended that the three special exclusion zones be employed.

When should I *not* use special exclusion zones?
If few or no false accumulations are observed within 25 n mi of the radar, special exclusion zones should not be used. Exclusion zones can still be used for other areas of persistent clutter.

Why should I be cautious about adding any exclusion zones?
In general, one should be as judicious as possible in defining exclusion zones, keeping in mind that the lowest uncontaminated, unblocked elevation should always provide the best precipitation estimate at any given location. However, exclusion zones, on occasion can

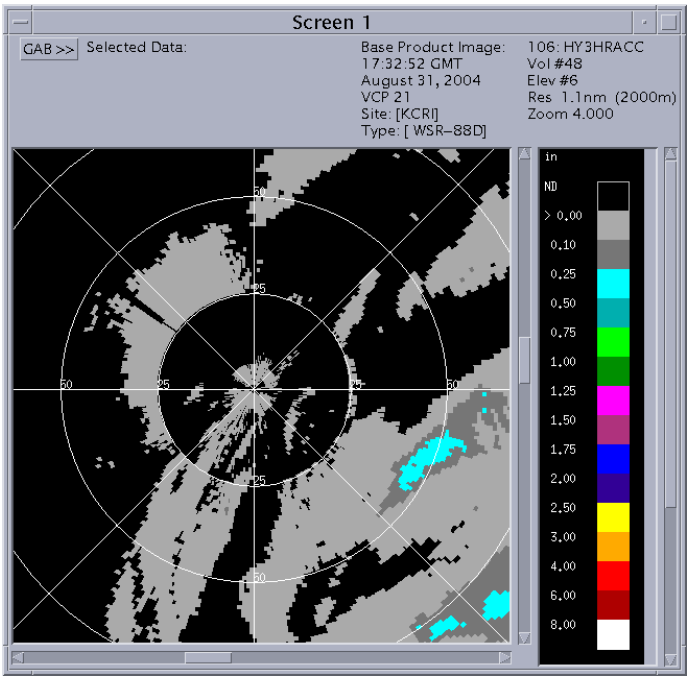

Figure 2 - Exclusion zones can cause rings of discontinuity. In this Three Hour Precipitation product a poorly defined exclusion zone, using a maximum elevation angle of 4.0 deg., caused a ring of discontinuity with a radius of 25 n mi.

produce undesired results. That is, exclusion zones can cause rings of discontinuity that are seen as underestimates in precipitation products, particularly from stratiform precipitation events.

How do I add exclusion zones?
To add and define an exclusion zone an operator must enter *six* Adaptable Parameter values of the Hydromet Preprocessing algorithm for each zone (see Figure 4). To add one exclusion zone the operator must first increment by 1 the value for "Number of Exclusion Zones [NEXZONE]." The next 5 values to enter for a single exclusion zone are:

1) Begin Azimuth
2) End Azimuth
3) Begin Range
4) End Range
5) Max Elevation Angle

An exclusion zone, once saved, modifies the precipitation and snow algorithms by excluding reflectivity data confined within the defined zone. Other algorithms and base data processing are unaffected by exclusion zones.

What if I want to reproduce special exclusion zones as they were hard-coded in Build 5?
Parameters of the special exclusion zones were chosen to fix the precipitation-from-clutter problem in RPG Build 5. Three zones were hard-coded and invisible to operators. These special exclusion zones no longer exist in RPG Build 6. By adding the values listed in Table 1 to the Hydromet Preprocessing adaptable parameters you will reproduce the hard-coded exclusion zones as implemented in RPG Build 5.

Special Exclusion Zones	
Number of Exclusion Zones (to add)	3
Begin Azimuth #1	0.0
End Azimuth #1	360.0
Begin Range #1	0
End Range #1	25
Max Elevation Angle #1	0.6
Begin Azimuth #2	0.0
End Azimuth #2	360.0
Begin Range #2	0
End Range #2	9
Max Elevation Angle #2	1.0
Begin Azimuth #3	0.0
End Azimuth #3	360.0
Begin Range #3	0
End Range #3	5
Max Elevation Angle #3	1.6

Table 1 - Special exclusion zones that were hard-coded in Build 5 can be duplicated in Build 6 using the adaptable parameter settings listed here.

What is an example of a small, less intrusive exclusion zone tailored to remove persistent ground clutter targets?

A wind farm near a WSR-88D site typically causes ground clutter that cannot be suppressed with current clutter suppression techniques. Reflectivity returns from a wind farm located about 20 n mi southwest of the Dodge City, KS WSR-88D are shown in Figure 3. A specific exclusion zone, as adaptable parameters shown in Figure 4, will eliminate false precipitation accumulations from the wind farm. Furthermore, the exclusion zone region is minimized so potential underestimates of real precipitation are minimized.

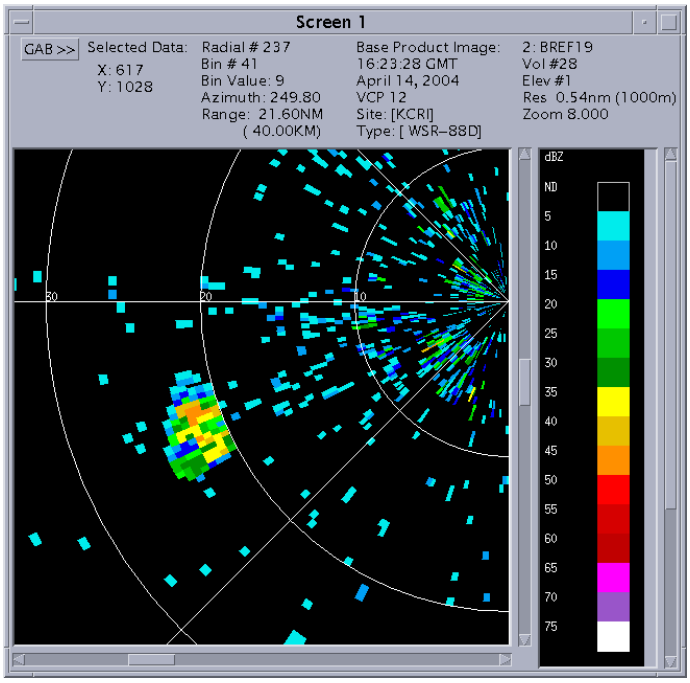

Figure 3 - A reflectivity product shows ground clutter caused by a wind farm located about 20 n mi southwest of Dodge City, KS.

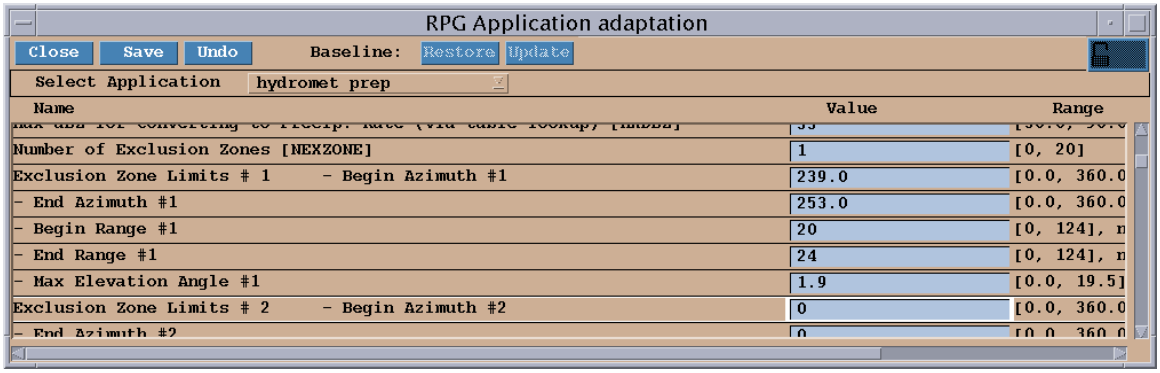

Figure 4 – Adaptable parameters used here to define a specific exclusion zone will eliminate false precipitation accumulations caused by the wind farm near Dodge City. The exclusion zone region is large enough to encompass the ground clutter from the wind farm yet small enough to avoid large scale underestimates of real precipitation often seen as rings of discontinuity in precipitation products.

Operational Impacts of ORPG Build 6

Velocity Dealiasing – Multi-PRF / VCP 121

The Velocity Dealiasing – Multi-PRF algorithm (also called the Multi-PRF Dealiasing Algorithm or simply MPDA), uses data collected in VCP 121 to reduce range folding (purple haze) and improve velocity dealiasing. It has three adaptable parameters that may be adjusted at the Unit Radar Committee level of authority. Two of these, Threshold (Fix Trip Minimum Bin) and Threshold (Fix Trip Maximum Bin) are used to eliminate noisy rings in Doppler velocity and spectrum width products and derived Doppler products near the end of first trip echo. In Build 6 the default values for these two parameters have been changed to -7 bins and -3 bins, respectively from the original values of 0 bins and -1 bins, respectively. Figure 1 shows the values used in Build 5 and Figure 2 shows the new values for Build 6.

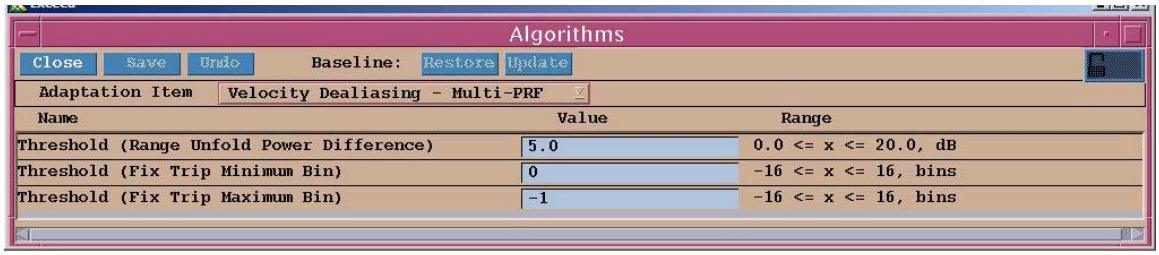

Figure 5. Graphical User Interface screen showing Build 5 default values for the site adjustable adaptable parameters Threshold (Fix Trip Minimum Bin) and Threshold (Fix Trip Maximum Bin) for the algorithm Velocity Dealiasing - Multi-PRF.

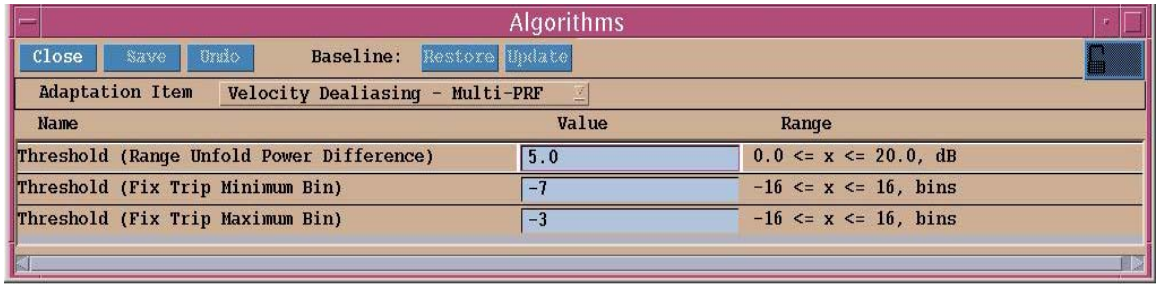

Figure 6. Same as Figure 1 but showing the Build 6 change to Threshold (Fix Trip Minimum Bin) and Threshold (Fix Trip Maximum Bin) to remove noisy rings of data near the end of first trip echo.

Why were these adaptable parameters changed?

Nearly all WSR-88Ds have a five bin deep ring of noisy Doppler data at the end of the first trip echo. For most volume coverage patterns, range-folded data, purple haze, just beyond the ring visually minimizes the ring's impact. However, in VCP 121, the ring may be readily apparent in widespread precipitation. When the radar is operating in VCP 121, the WSR-88D collects velocity data at three different PRFs and combines them to reduce range folding. Near the end of the first trip the values may be near zero or at the

Nyquist velocity over tens of radials. The velocity data may be within the algorithm's tolerance for surrounding velocities but the data are displayed as a discontinuous ring. (The corresponding Spectrum Width and Severe Weather Analysis products also display noisy rings.) Rings may be observed at the end of each PRF's unambiguous range. Figures 3 and 4, below, are examples of velocity products. Figure 3 is a 4-bit 16 data level velocity product and Figure 4 is an 8-bit 256 data level velocity product.

Are there any negative effects due to the new settings?

There may be a small loss of Doppler data at the range where the rings occur.

What if I still observe noisy rings?

If you still observe noisy rings contact the WSR-88D Hotline which, in consultation with the ROC's Applications Branch, will investigate the source of the rings and may recommend slightly different settings.

What if I never had any rings?

You may leave the new values for Threshold (Fix Trip Minimum Bin) and Threshold (Fix Trip Maximum Bin) just as they are or you may be set them back manually to the original values. Contact the Hotline if you need assistance setting these values back to their original values.

Why is there more clutter with VCP 121?

The reason there is more clutter with VCP 121 is because it uses fewer pulses per radial than other VCPs for surveillance scans. This results in a five-second faster scan each at 0.5 and 1.5 degrees elevation. Although the quality of the return from weather remains quite good, the ability to filter clutter is degraded. To compensate, the ROC recommends using high clutter suppression on the bypass map in the low sector reflectivity channel. For Build 7, we plan to increase the number of pulses in VCP 121 from 11 to 15 which will match that used by VCP 12.

Examples

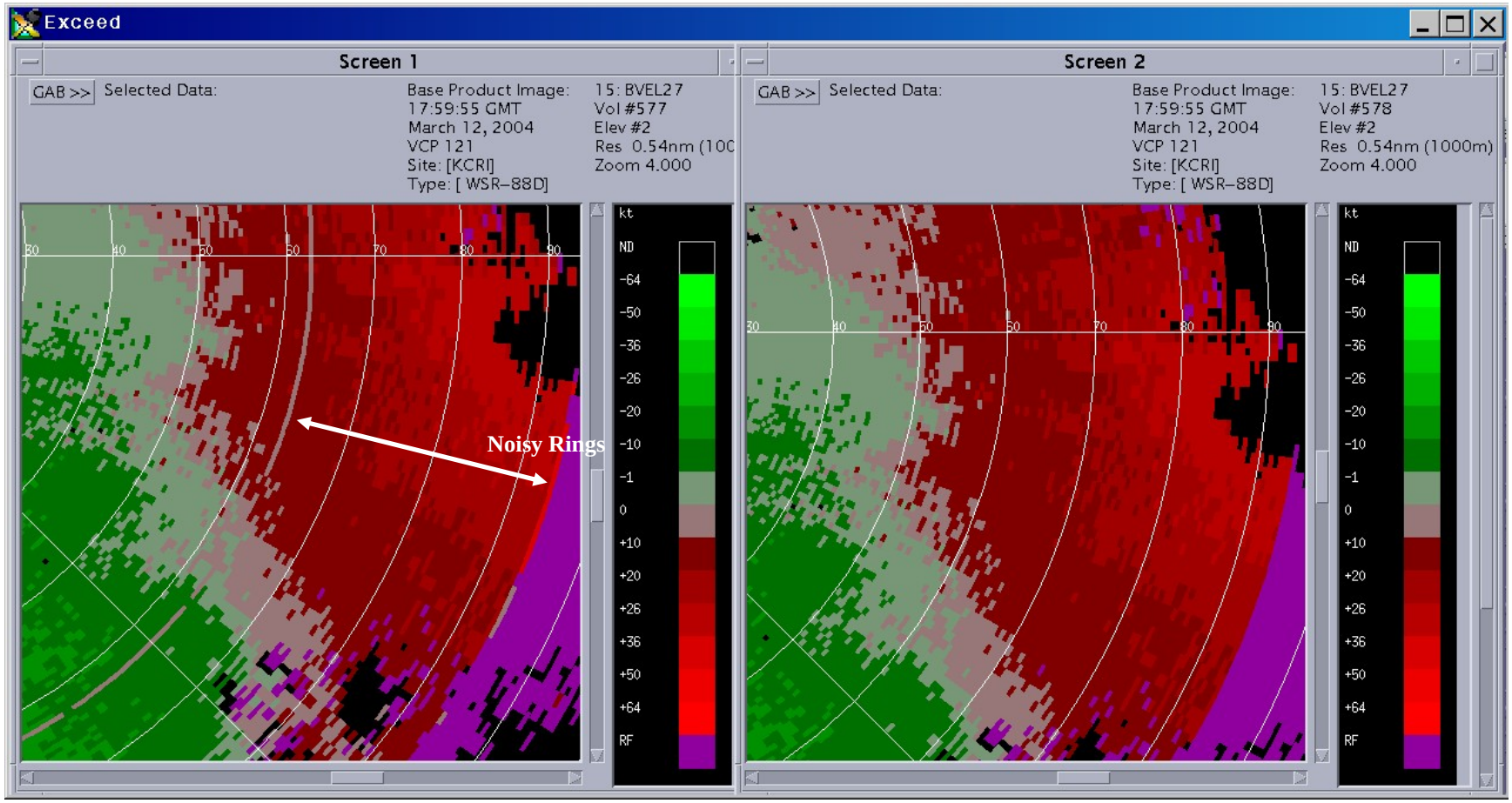

Figure 3. A 16 data level 1 km resolution velocity product at 1.5 degrees elevation from March 12, 2004 at 17:59Z. A 1 km wide ring of near zero velocities lies at a range of 63 n mi and a second ring of strong outbound velocities at 77 n mi is seen in the left image while the right image shows that the Build 6 fix, which sets Threshold (Fix Trip Minimum Bin) to –7 and Threshold (Fix Trip Maximum Bin) to -3, removes the rings. The white arrows point to the location of the rings.

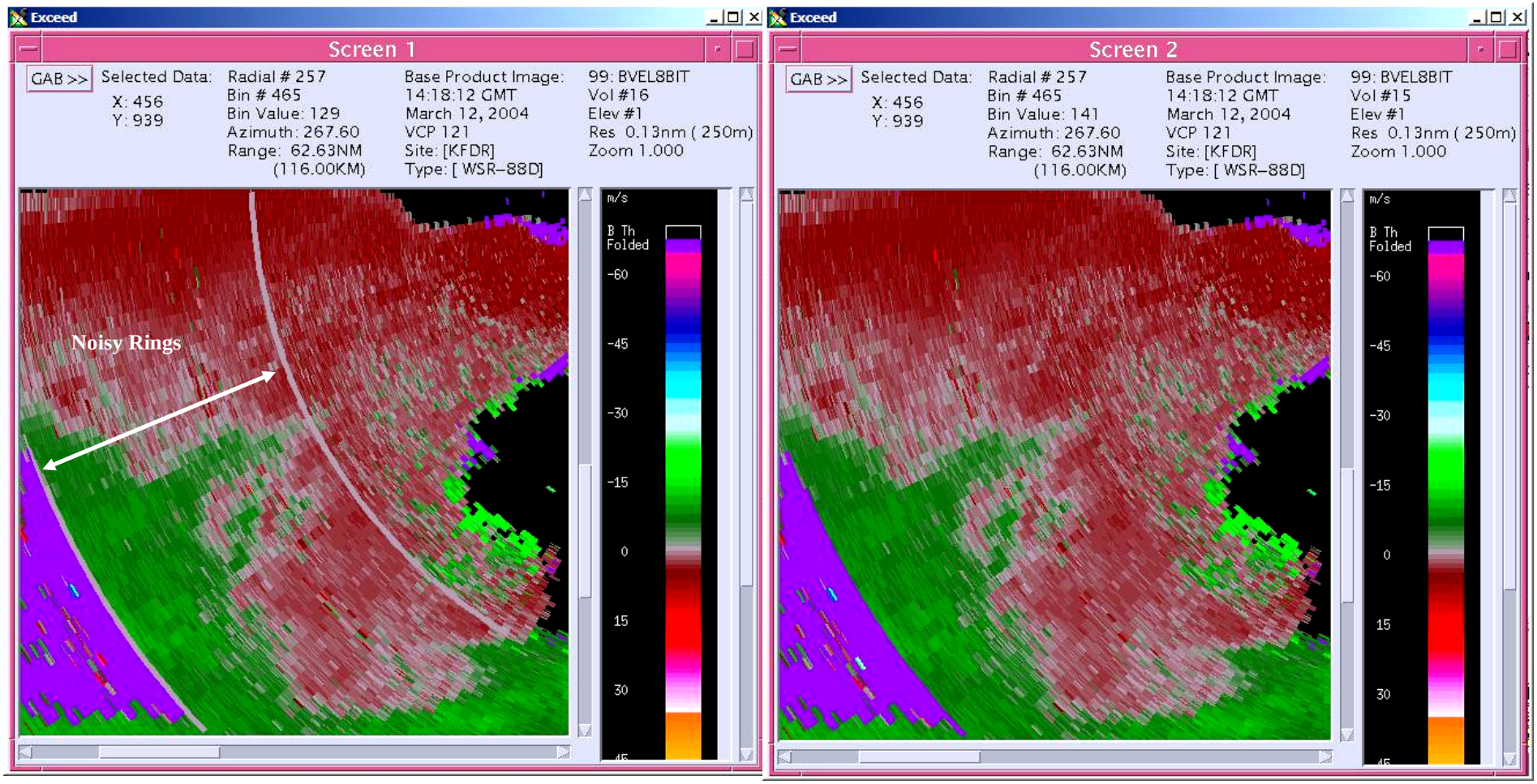

Figure 4. A digital (256 data level, 0.25 km resolution) velocity product from March 12, 2004 at 14:18Z at 0.5 degrees elevation. Rings near 63 n mi and 77 n mi in the left image has been removed in the right image by setting the Threshold (Fix Trip Minim Bin) to -7 and setting Threshold (Fix Trip Maximum Bin) to -3. The white arrows point to the location of the rings.